

ASTROMETRIC OBSERVATIONS OF COMETS AND ASTEROIDS
AND SUBSEQUENT ORBITAL INVESTIGATIONS

HQ. GRANT
IN-89-CR
174703
98.

Grant NGR 09-015-212

Semiannual Progress Report No. 30

For the period 1 May through 31 October 1988

Principal Investigators

Dr. Richard E. McCrosky

Dr. Brian G. Marsden

November 1988

prepared for

National Aeronautics and Space Administration

Washington, D.C.

Smithsonian Institution
Astrophysical Observatory
Cambridge, Massachusetts 02138

The Smithsonian Astrophysical Observatory
is a member of the
Harvard-Smithsonian Center for Astrophysics

The NASA Technical Officer for this grant is
Dr. Henry C. Brinton, Code EL-4, NASA Headquarters,
Washington, D.C. 20546

N89-15806

(NASA-CR-183000) ASTROMETRIC OBSERVATIONS
OF COMETS AND ASTEROIDS AND SUBSEQUENT
ORBITAL INVESTIGATIONS Semiannual Progress
Report No. 30, 1 May - 31 Oct. 1988
(Smithsonian Astrophysical Observatory) 9 p G3/89 0174703

Unclas

ASTROMETRIC OBSERVATIONS OF COMETS AND ASTEROIDS
AND SUBSEQUENT ORBITAL INVESTIGATIONS

Semiannual Progress Report No. 30

1. Personnel

Observations, data reduction and interpretation of results contributing to this research are performed by Principal Investigator R. E. McCrosky and Co-Investigator B. G. Marsden; and by C.-Y. Shao, C. M. Bardwell and D. W. E. Green as members of their research groups. The services of all except Shao, 25 percent of McCrosky and less than 10 percent of Bardwell are provided at no cost to NASA.

2. Observing Program

The 155-cm reflector was used for observations of comets and minor planets on 28 nights during April-October. The exceptionally poor summer weather meant that this was one of the most unsuccessful semesters for observations in many years, and only 123 positions were secured. May was particularly bad, yielding a total of only eight observations and on only two nights. Table 1 lists the 140 measurements, ten of them referring to observations obtained in 1987 and earlier, published in the MPCs since the last report. Twenty-two of the observations refer to comets, 62 to numbered minor planets (numbered, that is, by the end of the semester: only nine of them refer to minor planets already numbered at the time of the last report), and the remainder to unnumbered minor planets.

The observing and measuring has been done by McCrosky and Shao. Most of the checking of the results and the selection of objects to be observed was done by Bardwell. The reductions were mainly done on the NOVA computer at the Oak Ridge Observatory, while the remaining computations were done on a MicroVAX computer in Cambridge.

3. Results of Special Interest

Observations were made of four new comets discovered during the semester and an fifth discovered in January. There were also continuing observations of the interesting comet Wilson (19861), P/Tempel 2 and two other returning short-period comets.

Among the old numbered minor planets observed were the earth-approaching objects (1685) Toro and (1980) Tezcatlipoca, and the earth-approacher 1980 PA was numbered (3908), in part as a result of our observations, the recovery this year being successful because we caused the arc to be extended from six weeks to five months at the discovery apparition. (1685) and (3908) were the objectives of radar-bouncing efforts. We also followed up the new earth-approaching discoveries 1988 NF, PA, RO1, SM and TA.

The following minor planets were numbered entirely as the result of our observations: (3835) 1977 SD3, (3836) 1979 SR9, (3841) 1983 VG7, (3848) 1982 FH3, (3853) 1981 WG1, (3856) 1976 QX, (3885) 1979 HG5, (3892) 1941 HD, (3894) 1980 PQ2, (3902) 1986 AL, (3905) 1984 QO and (3919) 1984 DS.

4. Orbital Investigations

Computations of preliminary and improved orbits continued in routine fashion. Following our discovery that two of the comets we observed, 1988e and 1988g, had practically identical orbits (but were separated by 76 days), we made a detailed study of the relationship, suggesting that the two comets separated from each other at their previous perihelion passage, some 13 000 years ago, but that the components were orbiting around each other until the relative nongravitational force on them allowed them to escape from each other, evidently at some rather considerable distance from the sun.

5. Publications

Observations from Oak Ridge plates are included in the following publications issued during this half year: Minor Planet Circ. Nos. 13107-13111, 13134-13135, 13222-13224, 13239, 13355-13364, 13402, 13492-13493, 13538-13539, 13636-13640 and 13670-13671; IAU Circ. Nos. 4631, 4637, 4642, 4661 and 4662. Orbital computations are on Minor Planet Circ. Nos. 13143-13145, 13164-13171, 13292-13294, 13304-13314, 13434-13436, 13452-13471, 13580-13596 and 13673-13682; IAU Circ. Nos. 4599-4600, 4615, 4619, 4621, 4627, 4631, 4637-4639, 4642-4643, 4648, 4660-4662 and 4668.

Table 1

Positional measurements

The successive columns give the object's designation (/ = comet, * = new discovery), the UT date and time, the right ascension (in hours, minutes and seconds) and declination (in degrees, minutes and seconds) -- equinox 1950.0.

/1986l	1988 04 20.04276	06 48 26.39	+21 46 15.6
/1987g	1988 06 10.13630	15 35 58.45	+03 14 34.7
/1987g	1988 07 11.12219	15 24 15.58	-03 30 07.8
/1987g	1988 08 09.07873	15 52 37.58	-13 42 33.7
/1987g	1988 08 16.05755	16 05 23.03	-16 19 09.6
/1987g	1988 09 12.01572	17 14 42.79	-25 25 31.9
/1987p	1988 04 13.10344	07 08 53.46	+52 26 45.2
/1987p	1988 04 20.08968	07 32 32.28	+51 33 03.6
/1987r	1988 04 14.06032	06 02 47.34	+23 32 58.7
/1988a	1988 06 12.11114	11 12 46.35	+46 27 14.5
/1988a	1988 06 15.10797	11 20 40.84	+43 28 11.6
/1988a	1988 07 11.09981	12 06 15.10	+23 37 44.3
/1988e	1988 05 15.30110	22 30 23.22	+42 02 24.8
/1988g	1988 06 12.24741	22 16 29.94	+42 27 23.7
/1988g	1988 07 14.14356	21 33 14.04	+56 12 21.9
/1988h	1988 07 11.16911	19 46 59.03	+15 36 09.0
/1988h	1988 08 09.14049	19 13 37.37	+09 27 40.0
/1988h	1988 08 13.08792	19 09 23.15	+08 24 17.8
/1988h	1988 09 09.11461	18 46 51.79	+00 37 04.2
/1988h	1988 09 11.12834	18 45 44.25	+00 02 03.7
/1988j	1988 08 09.35080	04 58 30.41	+00 24 48.5
/1988j	1988 08 09.35829	04 58 33.30	+00 24 47.0
929	1988 09 12.26800	23 02 19.19	+00 42 23.4
929	1988 09 15.31087	22 59 32.16	+00 19 50.1
951	1988 09 09.03677	18 08 07.90	-19 28 16.5
1685	1988 06 11.30953	21 25 59.15	-11 59 54.6
1685	1988 06 14.29653	21 31 13.13	-10 45 06.6
1685	1988 07 11.29086	22 27 57.31	+08 47 35.2
1980	1988 06 11.27143	17 07 19.27	-05 47 57.2
1980	1988 07 14.10779	16 16 33.07	+12 47 23.3
3451	1988 09 12.26800	23 03 40.03	+01 02 21.6
3834	1988 04 13.19023	12 25 38.95	+16 51 28.3
3835	1988 03 19.17702	12 14 38.64	+00 44 03.1
3835	1988 04 13.14238	11 56 39.55	+04 11 38.6
3845	1988 04 18.14867	11 52 48.85	+00 19 49.0
3846	1988 04 19.23356	13 25 35.67	-13 31 09.9
3847	1988 04 18.17658	11 54 14.12	+05 04 42.7
3853	1988 04 18.22538	13 14 00.35	+04 18 28.8
3853	1988 05 15.18384	12 58 13.16	+05 34 45.7
3856	1987 11 19.42802	07 36 54.81	+23 26 55.1
3856	1988 02 17.06623	06 39 27.03	+24 45 12.2
3857	1985 09 12.19283	23 01 02.57	-11 17 35.6
3857	1988 04 20.27950	15 01 20.80	-16 04 02.8
3860	1987 11 21.37419	06 23 13.88	+28 26 32.2
3861	1988 04 20.31074	16 32 24.25	-16 36 40.0
3861	1988 06 10.15922	15 54 18.41	-12 40 37.9
3862	1988 05 15.23273	14 22 43.99	+01 30 11.8
3862	1988 06 14.12064	14 07 40.61	-00 33 00.5
3863	1988 04 13.30689	15 37 39.83	-07 48 12.5
3863	1988 05 13.25707	15 15 07.11	-03 39 19.6
3868	1987 05 02.05016	09 55 28.59	+12 13 50.4
3868	1988 06 14.24992	18 17 39.61	-09 13 46.6
3868	1988 07 14.20255	17 49 44.50	-09 58 05.5
3872	1988 04 14.34881	16 10 39.79	-05 10 35.7
3877	1988 05 15.11604	10 15 51.77	-04 02 05.9
3881	1988 03 18.37335	12 35 39.56	-00 19 00.2
3881	1988 04 13.16714	12 12 02.05	+01 33 34.5
3882	1988 04 14.30212	15 15 00.02	-14 27 06.7

3883		1988 04	14.32447	16 08	55.69	-04 34	05.4
3883		1988 05	13.27998	15 50	45.58	-01 11	03.0
3885		1988 04	19.25883	14 07	51.04	-04 46	08.6
3885		1988 05	15.21031	13 48	09.62	-02 54	24.8
3888		1987 02	25.15169	07 54	40.31	-01 42	59.6
3888		1988 06	12.30848	20 19	38.69	+18 53	13.1
3892		1988 07	11.24790	21 24	51.45	-03 37	49.0
3892		1988 08	09.22832	21 04	11.65	-07 19	00.4
3893		1988 05	15.26580	19 25	45.24	+12 42	40.9
3893		1988 06	11.29234	19 34	47.51	+21 25	10.0
3893		1988 06	15.26347	19 34	15.33	+22 26	38.9
3894		1988 07	14.17260	16 55	17.40	-02 45	26.1
3894		1988 08	10.07857	16 52	31.50	-05 56	48.5
3902		1988 07	11.22454	20 39	27.08	-14 54	54.4
3902		1988 08	10.19964	20 13	39.45	-14 01	26.0
3905		1988 08	10.31725	22 45	24.76	-13 55	34.7
3905		1988 09	14.15588	22 07	57.83	-13 56	44.0
3906		1988 09	14.28848	00 04	20.98	-18 36	11.6
3907		1988 07	11.26758	21 52	41.02	-03 51	14.9
3907		1988 08	09.24466	21 32	38.62	-02 44	38.1
3908		1988 08	09.20517	21 56	31.26	-03 49	08.7
3908		1988 09	09.22575	22 07	32.02	+08 22	53.2
3908		1988 09	12.18368	22 11	08.23	+10 24	46.5
3913		1988 08	09.32991	22 52	04.00	-05 12	22.3
3919		1988 06	14.18740	17 18	55.71	-14 35	17.6
3919		1988 08	10.09973	17 05	54.03	-17 35	39.6
1931	UE	1988 03	18.12331	08 05	32.16	+19 22	11.3
1948	WF	1988 06	14.16654	17 11	30.40	-12 48	26.5
1971	OH	1988 06	12.20823	18 22	57.50	-05 38	46.6
1971	OH	1988 07	14.22102	17 53	55.88	-06 52	04.0
1977	CD	1988 04	18.27483	13 50	23.18	+07 55	04.2
1977	CU	1988 08	09.31333	22 27	13.01	-10 23	24.8
1977	QW2	1988 08	13.23330	22 20	17.38	-02 24	00.1
1977	RH7	1988 09	14.31718	00 02	54.95	-03 30	19.9
1977	SS2	1988 08	13.30807	23 10	09.30	-02 33	51.0
1977	SS2	1988 09	09.28611	22 55	19.00	-07 05	56.6
1978	RS	1988 08	10.25725	21 34	12.68	-14 02	01.9
1978	RS	1988 09	16.10563	21 07	39.78	-15 07	38.7
1978	TU5	1988 08	10.23471	21 20	10.41	-14 18	30.3
1981	JA2	1987 02	28.20058	09 22	41.28	+12 05	57.6
1981	WG9	1987 05	02.19563	13 29	07.77	-05 15	59.8
1981	WG9	1988 08	13.28962	22 38	03.30	-08 19	02.3
1981	WG9	1988 09	14.17758	22 12	35.35	-11 51	02.2
1982	TL1	1987 11	23.05711	00 16	55.52	+03 47	49.4
1982	UP6	1988 06	12.12607	14 08	14.34	-02 39	53.6
1982	UP6	1988 07	16.08318	14 30	47.02	+00 02	58.0
1982	UG7	1988 08	10.34072	22 49	28.03	-02 22	50.1
1982	UG7	1988 09	12.24732	22 26	55.38	-05 29	46.1
1983	AY	1988 09	12.16017	21 42	29.32	-06 22	51.1
1983	BE	1988 04	18.04047	07 58	44.83	+26 29	15.6
1984	EN	1988 04	19.20883	13 15	29.51	-13 57	42.6
1985	PB1	1988 06	10.18833	15 58	27.73	-10 39	51.4
1985	RF	1988 06	15.19580	16 35	48.67	-16 50	58.5
1985	UL	1988 09	12.26800	23 02	10.68	+01 04	19.5
1985	UL	1988 09	15.31087	22 59	17.87	+00 43	54.7
1985	VK2	1988 04	20.06977	08 39	33.56	+41 14	57.5
1986	CH	1988 08	09.27036	21 35	51.66	-03 07	23.2
1986	RC2	1988 04	14.21696	13 03	33.74	+07 28	14.1

1986	TM		1988	04	13.12372	11	56	17.14	+05	40	17.0
1987	OV1	*	1987	07	29.30547	21	48	03.04	-07	56	07.2
1987	QG9	*	1987	08	22.19266	21	25	09.84	-10	28	20.1
1988	BN		1988	04	14.02782	08	50	30.54	-03	05	59.7
1988	BX1		1988	03	17.12842	07	06	30.04	+44	27	50.7
1988	BX1		1988	04	13.08119	07	15	07.99	+43	28	32.6
1988	BY1		1988	03	17.15385	07	28	48.42	+45	05	23.2
1988	BY1		1988	04	13.05297	07	36	39.51	+43	09	13.2
1988	DE2		1988	02	19.19590	07	40	47.73	+24	42	06.9
1988	JB1		1988	07	11.14682	17	01	36.97	+08	29	42.8
1988	JB1		1988	08	09.10138	17	11	07.22	-00	24	20.2
1988	NF		1988	08	09.18690	23	28	58.49	+49	45	38.0
1988	NF		1988	09	15.37086	23	53	10.38	+59	55	22.0
1988	NF		1988	09	15.38175	23	53	10.47	+59	55	22.6
1988	NF		1988	10	06.40941	23	59	16.80	+57	13	55.6
1988	PA		1988	08	16.26060	20	37	19.56	-04	50	43.2
1988	PA		1988	08	16.28420	20	37	21.17	-04	51	21.6
1988	PA		1988	09	09.14761	21	13	04.65	-13	58	45.6
1988	RO1		1988	10	06.17148	00	36	07.81	-03	14	35.4
1988	SM		1988	10	07.09096	22	21	01.16	-05	03	21.2
1988	TA		1988	10	10.32720	01	27	10.10	+07	35	31.7
1988	TA		1988	10	13.18552	01	24	35.41	+06	20	38.3
2321	T-3		1988	08	09.29242	22	11	44.64	-00	18	22.5
2321	T-3		1988	09	09.17317	21	46	06.65	-02	54	33.5

Addendum

The final stage of the work authorized as a special supplement to this grant in connection with supernova 1987A in the Large Magellanic Cloud was essentially completed during this semester.

Arrangements were completed in July allowing the IAU Circulars to be e-mailed to institutions and individuals who subscribe to the Central Bureau for Astronomical Telegrams' Computer Service. More than half of the 140 Computer Service subscribers are now being serviced in this way. The possibility that users can still also log in to a MicroVAX to obtain the Circulars is very desirable because of the delays and losses all too frequently experienced with e-mail.

As discussed in the last report, ports were finally inserted on the MicroVAX CFAPS2 in September. This immediately allowed us to use the MicroVAXes, rather than two antiquated TWX machines, for communication by telex and over other commercial networks. Modernization is therefore complete.

The supernova still continues to be of interest, but the number of IAU Circulars devoted to it has now become rather small. Somewhat surprisingly, although professional interest remains, the monitoring of the supernova's brightness by amateur astronomers dropped dramatically during this semester, even though the object is still significantly brighter than the novae that occur in the LMC from time to time and command a fair bit of amateur interest.